Claims

There is claimed:

1. ~~A digital filter combination for interpolating primary sample values (sp) of a~~ sampled signal (sg) using an mth-order discrete-time filter (1) and a kth-order continuous time interpolation filter (2), with $m \geq 3$ and $k \geq 2$, wherein

the discrete-time filter (1) forms n secondary sample values (ss) from at least m + 1 primary sample values (sp) at equal time intervals (T*; T/2), with $n \geq m$, and

the continuous-time interpolation filter (2) forms from at least part of the n secondary sample values (ss) an interpolated value (st) whose temporal position with respect to that of the primary sample values (sp) is predeterminable by a normalized interpolating instant $dp = t_{in}/T$, where t_{in} is the absolute interpolating instant, and T is the period of the primary sampling rate.

2. The filter combination according to claim 1, wherein the discrete-time filter (1) is a third-order filter whose secondary sample values (ss), including the primary sample values (sp*), correspond to a secondary sampling sequence whose data rate is twice that of the primary sample values (sp), the discrete-time filter providing at its output end at least k secondary sample values (ss) for the continuous-time interpolation filter (2).

3. The filter combination according to claim 2, wherein the discrete-time filter (1) further includes:

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a delay chain formed from at least a first delay stage, a second delay stage, and a third delay stage, each said delay stage providing a delay equal to the period T of the primary sampling rate;

the input of the first delay stage being connected to a first input of a first adder, and the output of the first delay stage coupled to a first input of a second adder having its second input connected to the input of the third delay stage, whose output is coupled to a second input of the first adder; wherein

the outputs of the first and second adders are connected, respectively, to the minuend input and the subtrahend input of a first subtracter having an output coupled through a first multiplier to a first input of a third adder which has a second input connected to the output of the second adder and whose output is coupled through a second multiplier to a second output of the discrete-time filter (1) and through a fourth delay stage, which provides a delay equal to the period T of the primary sampling rate, to a fourth output of the discrete-time filter (1); and

a tap between the first and second delay stages, said tap coupled to a first output of the discrete-time filter (1), and a second tap between the second and third delay stages coupled to a third output of the discrete-time filter (1).

4. The filter combination according to claim 1 wherein the continuous time interpolation filter (2) implements a second-order Lagrange interpolation.

5. The filter combination according to claim 4, wherein the continuous-time

interpolation filter (2) includes:

said continuous-time interpolation filter (2) being fed from the discrete-time filter (1) at first, second, and third inputs with the secondary sample values (ss) of the normalized instants dp = -1, -3/2, -2 or dp = -3/2, -2, -5/2, which define first, second, and third sample values (s1, s2, s3);

said first sample value (s1) being fed to the second input of a fourth adder and to the minuend input of a second subtracter;

the second sample value (s2) being fed to a third multiplier and to the first input of a fifth adder;

the third sample value (s3) being fed to the first input of the fourth adder and to the subtrahend input of the second subtracter;

the output of the third multiplier being connected to the subtrahend input of a third subtracter whose minuend input is fed by the output of the fourth adder;

the output of the third subtracter being coupled to the input of a fourth multiplier whose output is coupled to the first input of a sixth adder having its second input connected to the output of the second subtracter;

the output of the sixth adder input to a fifth multiplier having its output coupled to the second input of the fifth adder; wherein

the third multiplier performs a fixed multiplication by a factor of 2; and

the fourth and fifth multipliers multiply the applied data values by the values of

normalized secondary interpolating instants d and d/2, respectively, the normalized secondary interpolating instant d being formed by normalizing a secondary interpolating instant t^*_{in} to the secondary sampling rate T^*, with $d = t^*_{in}/T^*$, and the secondary interpolating instant t^*_{in} being referred to the closest secondary sample value (ss, sp*).

6. The filter combination according to claim 1, wherein a gang switch controlled by the normalized interpolating instant dp and having at least a first switch position (p1) and a second switch position (p2) is interposed between the outputs of the discrete-time filter (1) and the inputs of the continuous-time interpolation filter (2).

7. The filter combination according to claim 6, wherein the first switch position (p1), the first, second, and third outputs of the discrete-time filter (1) are connected, respectively, to the first, second, and third inputs of the continuous-time interpolation filter (2), and wherein the second switch position (p2), the second, third, and fourth outputs of the discrete-time filter (1) are connected, respectively, to the first, second, and third inputs of the continuous-time interpolation filter (2).